Environment, Development and Sustainability (2022) 24:7811–7832
https://doi.org/10.1007/s10668-021-01759-5

Residents' willingness-to-pay for watershed conservation program facilitating ecosystem services in Begnas watershed, Nepal

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Received: 14 August 2020 / Accepted: 9 August 2021 / Published online: 25 August 2021

Abstract
Residents' willingness-to-pay for watershed conservation plays a crucial role in developing sustainable market-based ecological protection strategies. The main objective of this study was to assess local residents' willingness-to-pay for the protection and conservation of the Begnas watershed ecosystem services, which was estimated using a contingent valuation method. Particularly, the study assessed the factors that affect the residents' willingness-to-pay using the Heckit model generating knowledge crucial to design watershed conservation programs and market-based protection strategies. The total willingness-to-pay was worth of \$203,598.15 year^{-1}, and the average annual willingness-to-pay of a household (US\$ 33.95) indicated the high importance of Begnas watershed conservation. Likewise, the results from econometric modeling showed a positive relationship between factors, namely gender (male resident), household size, education level, occupation (tourism and agriculture), income, and landholding size with the residents' decision to pay for the watershed conservation. These findings imply that a public-funded watershed conservation program is feasible in the Begnas watershed. Further, local resident participation in the program is seen increased because of the potential improvement in watershed ecosystem services, which are directly related to their livelihoods.

Keywords Contingent valuation · Ecosystem services · Heckit model · Watershed · Willingness-to-pay

1 Introduction

Ecosystem services (ESs) are the both direct and indirect benefits available from ecological functions of natural resources (MEA, 2005; Westman, 1977). Watershed ecosystem contributes to human well-being by ensuring goods and services such as natural water purification, flood control, opportunities for recreation, provision of food in the form of aquatic plants and animals, carbon sequestration, and many more (Fisher

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et al., 2009; De Groot et al., 2010; Tengberg et al., 2012; GC et al. 2018; Thapa et al., 2020). However, watershed ecosystem services are continuously degrading due to soil erosion, land-use change, and overexploitation of natural resources.

Begnas watershed system (BWS) is a hilly catchment declared as *Ramsar* site holding international importance (Ramsar, 2016; Kafle & Savillo, 2009). The watershed provides plethora of benefits, services, and income sources to the communities living around (Thapa et al., 2020). Despite their ecological and economic significance, watersheds in the world are continuously deteriorating due to the lack of effective conservation models and adequate resources to implement conservation practices (MEA, 2005; Thapa et al., 2020; Yang et al., 2018). Beneficiaries of the watershed can be financial contributors to manage watershed and sustain benefits (Jayathilaka & Serasinghe, 2018), so the assessment of potential contribution from beneficiaries is crucial for the sustainable conservation of watershed. So far, few studies (e.g., Gelal, 2017; Thapa et al., 2020) have conducted feasibility assessment for payment for ecosystem services (PES) in the region. Empirical studies focusing on assessing primary stakeholders' willingness-to-pay (WTP) for acquiring the benefits and services from the watershed are still lacking. Assessment of WTP based on parametric technique is crucial to narrow down the limitation of previous study and provide reliable and valid estimation to concerned stakeholders for preparing implementable plan with proper budget allocation. Due to the lack of knowledge about the benefits of such program, the policy makers are facing difficulty to keep the watershed management program in national priority.

To fill the above knowledge gap, this study has covered larger number of stakeholders residing in the Begnas watershed system to estimate WTP using contingent valuation method and also has identified the factors that affect beneficiaries to make decision of paying. Explicitly, this study has targeted four major issues: (1) residents' maximum WTP for conservation of BWS for the next 5 years, (2) factors affecting the residents' WTP, (3) residents' attitude toward WTP, and (4) available ecosystem goods and services.

We elicited the residents' WTP on the basis of face-to-face interviews with households living in and within 49 km^2 of the watershed (Rai, 2000). To avoid sampling bias, we divided the area into three strata and conducted stratified random sampling to select benefitted households. In order to get reliable information, we presented a hypothetical scenario (further discussed in the methodology section) with residents to ask about their willingness-to-pay. As this study was designed based on contingent valuation method (CVM), we used the Heckit model suggested by James Heckmann 1979 for data analysis due to questionnaire being in payment card format and due to the necessity of analyzing participation decision and decision related to the level of payment separately. So that, the study findings would work as a strong backstopping to concerned stakeholders to prepare effectual management plan with reliable budget estimation for sustainable management of the watershed. Thus, the economic values derived from such studies suggest the societal preferences and provide significant input for policy makers regarding watershed management and restoration in developing countries (Girma et al., 2020).

The following section describes the theoretical basis of this study before moving on to the research methodology that includes the description of the study area, theoretical framework, research design, data collection procedure and econometric model used in the study. Study results is followed by the discussion. Lastly, the article offers the conclusion and implication of the study.

2 Literature review

An integrated resource management without compromising the sustainability of environmental systems is a major concern to meet an increased demand of ecosystem goods and services. Due to escalated demand of ecosystem services and limited information of valuation are major challenges to policy makers in building effective watershed management programs. The valuation of watershed benefits justifies the suitable investment to regulate watershed ecosystem services.

The PES helps to enrich participation of relevant stakeholders to maintain the ES, and monetary valuation helps design a good scheme. A study conducted by Khatri (2011) in the Kulekhani watershed found that the PES scheme had a positive impact on the livelihoods of upstream communities and helped reduce sedimentation in the Kulekhani reservoir. The monetary valuation of ES is mainly based on WTP for ecosystem gains and willing to accept (WTA) compensation for avoiding some ecosystem losses (Turkelboom et al., 2015). WTP is a common welfare measure applied for determining the amount that residents are willing to pay to use, improve, and maintain ES (Cardinale et al., 2012; Nicosia et al., 2014). Past studies emphasized the importance of estimating WTP for determining value preferences among interest groups (e.g., residents vs. non-residents), selecting better management alternatives, and protecting natural ecosystems effectively (Castro et al., 2016; Dietz et al., 2005; Halkos, 2013). However, previous studies merely focused on how monetary values of watershed ecosystem services vary due to the diversity within an interest group (e.g., residents), in terms of their socioeconomic characteristics and familiarity about ecosystem services.

The CVM has been used in many environmental valuation studies, for example, the study that explored downstream resident's WTP for ecosystem services in the Chure region of Nepal (Bhandari et al., 2016). The study suggested that, if the quality of the water services was assured and the flow was sustained, the downstream community would be willing to pay a higher amount ($30.30/year/household) for water services than erosion control and landscape beauty. WTP of downstream communities for overall watershed services, however, was $12.12/year/household. Likewise, contingent valuation study conducted by Alemu et al. (2021) in the Upper Blue Nile basin, Ethiopia, estimated the farmer's WTP for sustainable land management practices in the form of labor contribution in average is 9.4 man-days per year. In the same way, Girma et al. (2020) also used CVM to estimate farmer's contribution to restore the lake in Ethiopia. The study estimated WTP of $31.1 annually for the improvement of water quality and levels permanently. Moreover, a contingent valuation study conducted by Rodriguez-Tapia et al. (2017) estimated household's WTP for drinking water in Mexico City. The study revealed that if the water quality is improved, the community people would be willing to pay 0.22% of their family income indicating higher demand of better water quality in the urban areas. Similarly, another contingent valuation studies also indicated higher WTP of urban residents for safe drinking water because of public health concerns (Bilgic, 2010; Chatterjee et al., 2017; Tumer, 2019). These water quality valuation studies informed local municipalities on how much resources they can allocate for water treatment or protection of water sources. However, the study showed that government efforts or resource allocation for improving watershed ecosystem services may depend on specific physiographic location and awareness level of the residents about ecosystem services.

Most studies using the CVM mainly focused on exploring factors like gender, income, culture, perception, regional differences, and payment amount that influences WTP. Xiong

et al. (2018) also applied the CVM to discover the factors affecting the WTP and payment level for ecological environment improvement in the Ganjiang River Basin. This study indicated that residents who have higher education level, stable work, and belong to a region with higher per capita gross domestic products have a stronger WTP for ecological protection compared to other residents of the river basin. According to the study conducted by Bhandari et al. (2018), independent variables such as income, position held in environmental committee, age, education level, and family size were positively related to WTP and factors like gender (female), number of livestock and distance to the forest were negatively related to WTP. Acharya et al. (2021) estimated willingness-to-pay of forest-dependent communities for regulating and cultural ecosystem services in Chure region of Nepal and found that WTP of forest users was affected by their economic status, distance from forests, and household size. The above studies underscore the importance of using variables related to individual attitudes, proximity to natural ecosystems, and socioeconomic characteristics in CVM study. Watershed ecosystem services such as irrigated water and water-based recreation are crucial for agriculture and tourism businesses; however, the WTP of beneficiaries or residents associated with it is still unknown.

This study aims to determine the residents' willingness-to-pay for protection and conservation of watershed ecosystem services and their attitude and preference toward watershed ecosystem services in BWS. Also, this study used an advanced econometric technique that led to the development and application will create a basis to design a PES scheme to link upstream and downstream communities and generate multiple benefits at local and regional levels. This study also helps to enhance residents' participation in improving watershed ecosystem services by adopting a participatory approach, as local residents have a better understanding about the local situation than outside experts (Nightingale, 2005; Ojha et al., 2009). Thus, this study provides references and support for construction of an ecological investment mechanism, which will help in the formulation of a watershed management policy.

3 Materials and methods

3.1 Study area

The study area of this research is the Begnas Watershed System. It is situated in the mid-hills of Nepal between 28°7′ to 28°12′ N latitude and 84°5′ to 84°10′ E longitude covering a surface area of 49 km^2 (Fig. 1). After the recent local administrative units restructuring by the government of Nepal, the Begnas watershed system lies in wards 28, 30, and 31 of the Pokhara Metropolitan City (Note: Ward is an administrative unit, like township in the USA). The total number of households in the study area is 5997 with a total population of 22,928 (CBS, 2011; Pokharel & Khanal, 2018). The Begnas lake is the second largest highland freshwater lake system designated as a wetland of international importance (Ramsar site) in 2016 along with other lake clusters in the Pokhara Valley. The major source of water to the lake is Syankhudi River along with other supporting seasonal inlet streams, namely the *Lipdi*, *Maladi*, and *Majhikuna*. The outlet stream is *Khudi* River. The watershed includes three distinct landforms: steep to very steep hill slopes to the north, a valley to the south and southeast, and Begnas Lake located at the confluence of these two landforms. The elevation ranges from 600 m in the south to 1440 m to the north. The climate of the area is subtropical in the valley floor and warm temperate to the north.

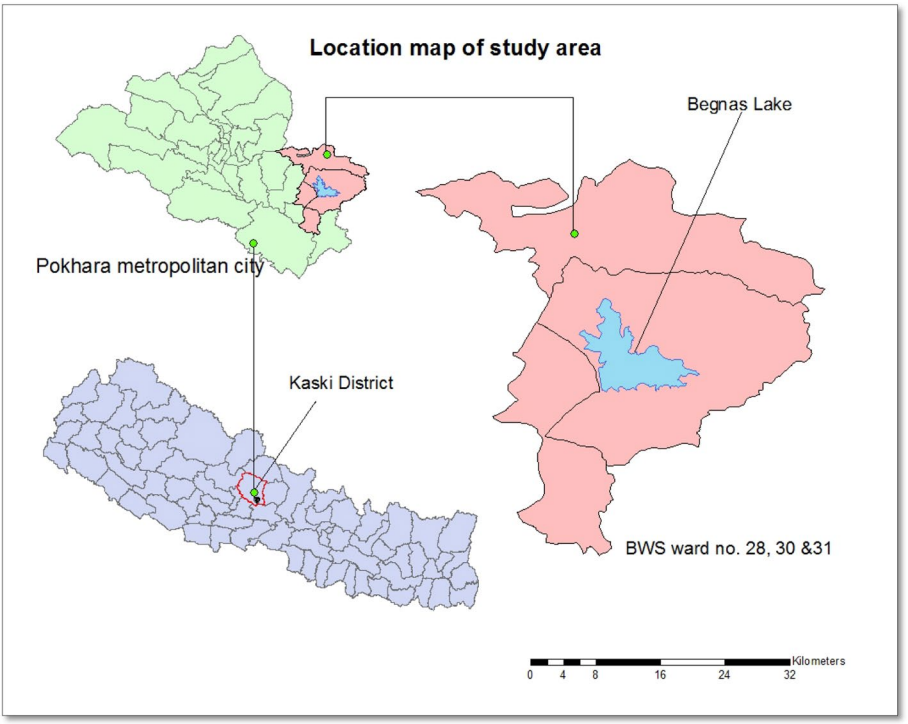

Fig. 1 Location map of study area showing Begnas watershed system inside Pokhara metropolitan city of Nepal

4 Contingent valuation method

The CVM is a widely accepted monetary valuation method used to determine the values of non-market environmental services (Hanemann, 1994; Hannan 1989). This is a frequently used method for environmental impact assessments of nonuse value of ecosystem services (Bishop & Heberlein, 1979; Kumar, 2010). The CVM includes a questionnaire where respondents are asked about their maximum willingness-to-pay for a hypothetical improvement or avoiding deterioration of environmental services (Venkatachalam, 2004; Barr & Mourato, 2009; Fogarassy 2016). While measuring the maximum WTP of local inhabitants for the conservation of watershed and identifying the factors that affected their preferences, we used both labor contribution and cash payment to represent residents' WTP amount in CVM questionnaire (Bhandari et al., 2018). Labor contribution is realistic in a subsistence economy like in the Begnas areas (Rai & Scarborough, 2012), where most of the economic transactions are still non-monetized. Therefore, we converted labor contribution into monetized value based on average wage rate of the study area (i.e., NRS 500 per day) as an opportunity cost of labor.

Despite its wide acceptance, CVM has some biases (Harris & Roach, 2013), such as design bias (partiality in the establishment of initial bids of the payment vehicle), operational bias (being unfamiliar with the good to be valued), hypothetical bias (difference between what a person indicates they would pay in the survey and what a person would

actually pay), and strategic bias (individual's intention not to reveal their actual preferences) (Van, 1999; Carson & Groves, 2011; Loomis, 2014); however, the CVM is widely accepted and only a feasible method for environmental assessment of nonuse values by many decision makers (Whittington & Pagiola, 2012). Each potential bias can be controlled to a certain degree through careful study design to improve the quality and reliability of results (Arrow 1993; Venkatachalam, 2004). In this study, we minimized the design and operational biases by establishing bids based on past studies and a pretest survey. Similarly, we applied ex ante approaches for reducing the hypothetical bias in our study. We shared the problem of hypothetical bias with respondents about consequences of past researches on implementation due to over-estimation of WTP. Thus, respondents were asked to answer what they would do if this were a real decision. This approach was also used by Cummings & Taylor (1999), Aadland & Caplan (2003), Aadland & Caplan (2006), and Landry & List (2007). We also requested respondents to explore others (their neighbors) WTP rather than exploring owns. Babbie (1992), Lusk & Norwood (2009), and Norwood & Lusk (2011) also applied these approaches to reduce the hypothetical bias. While the strategic bias was difficult to control, we tried to reduce this bias by informing the participants that their identity would remain anonymous, their responses remain confidential, and only analyzed results would be published. This information was given to the participants prior to the survey.

Another major consideration in CVM is the use of payment vehicle. Johnston et al. (2017) stated that "payment vehicle selected should be realistic, credible, familiar, and binding for all respondents." They further stated that there is "no single objective criterion that identifies what payment vehicle is best for a particular application." In developing countries like Nepal, a non-binding mechanism is unavoidable. Thus, in the context of this study, labor contribution or direct cash (donations) is the only realistic option for payment vehicle instead of others (e.g., taxes, user fees). As rightly stated by Friedman (2016), "respondents experience should be carefully considered when selecting a payment vehicle," especially in the developing world context. Since there was virtually no indication of the respondents' dissatisfaction with our payment vehicle based on pretest results, we strongly believe that labor contribution or donation is the most realistic and credible payment vehicle type for this study.

Some studies highlighted that donation can result to lower bound estimates on values due to free-riding tendencies (Champ, 1997; Bateman et al., 2006; Kwak et al., 2007); this is more so when an open-ended elicitation procedure is employed (Foster, 1997). In the Nepalese context, even though there is less liquidity availability, the motivation of donating to address a problem with public goods is entrenched in people's culture and religion. Thus, we applied CVM using payment card format instead of other stated preference methods such as Choice Experiment (CE) because of the experimental complexity involved in the latter, which could potentially lead to a greater hypothetical bias, especially for respondents who have never participated in such studies (Aguilar et al., 2018; Khan et al., 2018; Ledoux & Turner, 2002; Sukhdev et al., 2010).

5 Computation framework: econometric model

Residents were asked about the amount they were willing to pay only after they stated their interest to pay for the hypothetical watershed conservation program. Residents who stated that they do not want to pay were not asked about the amount. This study aimed to identify the

characteristics of residents who are interested in paying for watershed conservation programs and estimate average willingness-to-pay amount. Thus, a sample-selection bias can occur if the econometric model only incorporates respondents who are willing to pay for the program. Therefore, we used the two-step sample-selection (Heckit) model as suggested by James Heckman in 1979 (Cho et al., 2005; Ficko & Boncina, 2015).

The Heckit model consisted in two equations: the selection equation (Eq. 1) and the outcome equation (Eq. 5) (Greene, 2018). The selection equation, which was estimated by using a probit model, determined whether the respondent was willing to pay for watershed conservation program.

$$z_i^* = \boldsymbol{w}_i^{'}\boldsymbol{\gamma} + u_i \tag{1}$$

$$z_i = \begin{cases} 1 & z_i^* > 0 \\ 0 & \text{otherwise} \end{cases} \tag{2}$$

where z_i* is a latent variable representing respondent willingness-to-pay in watershed conservation program, z_i is the observed value of respondent willingness-to-pay, w' is a vector of independent variables, γ is vector of parameters, and u_i is error term.

Similarly, the WTP model, also known as outcome equation, is a linear model with X representing vector of independent variables, β is vector of parameters, and e_i is an error term (Eq. 3). Error terms of both equations had a bivariate normal distribution (Eq. 4).

$$WTP_i = \boldsymbol{X}_i^{'}\boldsymbol{\beta} + e_i \text{ obseved only if } z_i = 1 \tag{3}$$

$$(e, u) \sim \text{bivariate normal } \left[0, 0, \sigma_e, 1, \rho\right] \tag{4}$$

Because of selectivity problem and correlation of error terms (ρ), only the conditional regression function (Eq. 5) provided the consistent estimates of WTP model parameters.

$$E\left[WTP_i | z_i = 1, \boldsymbol{X}_i, \boldsymbol{w}_i\right] = \boldsymbol{X}_i^{'}\boldsymbol{\beta} + \rho\sigma_e\lambda\left(\boldsymbol{w}_i^{'}\boldsymbol{\gamma}\right) \tag{5}$$

where $\lambda\left(\boldsymbol{w}_i^{'}\boldsymbol{\gamma}\right)$ is inverse mills ratio and is computed by using Eq. (6):

$$InverseMillsratio\lambda\left(\boldsymbol{w}_i^{'}\boldsymbol{\gamma}\right) = \hat{\lambda}_i = \phi\left(\boldsymbol{w}_i^{'}\hat{\boldsymbol{\gamma}}\right)/\Phi\left(\boldsymbol{w}_i^{'}\hat{\boldsymbol{\gamma}}\right) \tag{6}$$

The inverse Mills ratios for each observation were computed using the probit model, which was estimated in the first stage. In the second stage, the ordinary least squares method was used to estimate the outcome equation (Eq. 5), which included X set of variables and inverse mills ratios as independent variables. In the WTP model (outcome equation), the marginal effects of the independent variables are computed using Eq. (7) (Greene, 2018):

$$\partial E\left[WTP_i | z_i = 1, \boldsymbol{X}\right]/\partial \boldsymbol{X}_i = \boldsymbol{\beta}_i - \boldsymbol{\gamma}_i\rho\sigma_e\left[\delta\left(\boldsymbol{w}'\boldsymbol{\gamma}\right)\right] \tag{7}$$

where $\delta\left(\boldsymbol{w}'\boldsymbol{\gamma}\right) = \lambda\left(\lambda + 2\boldsymbol{w}'\boldsymbol{\gamma}\right)$

6 Research design, sampling techniques, and data collection methods

Before data collection, oral and written consent was acquired for the study involving human research subjects. The oral consent was acquired from the participating households and stakeholders. Similarly, the questionnaire survey, interview protocol, and written consent were approved by the Beijing Forestry University. The survey was administered through face-to-face questions, which also focused on the public awareness for the conservation of BWS. The face-to-face interview is an excellent way to enhance communication with the respondents and transmit a message that is necessary for the CVM (Liu, 2017). Before implementing questionnaire survey, a pretest survey was conducted to ensure the reliability of questionnaire design, expression approach, and payment vehicle.

The sample size for the study was selected from the total households of three wards (wards 28, 30, and 31) of the Pokhara Metropolitan City. Altogether, 400 respondents (households) were selected for our WTP survey from 5997 total households. Stratified random sampling was used to select the survey participants. The study area was divided into three strata based on the administrative boundary. For the distribution of sample size, we first grouped the respondents on the basis of benefits they were deriving from the watershed; for example, respondents were divided into boaters, fishers, hotel service and others. Then, we distributed the sample size proportionally by adopting stratified random sampling in each ward (i.e., ward 28, ward 30, and ward 31, respectively). After determining the sample size proportionally in each ward, we walked in transect/road and approached the respondent in every fourth house along the transect line. We approached the household head for the survey, but in case of absence of the household head, an available adult was approached and interviewed with a structured questionnaire. The survey questionnaire was reviewed by two experts in the field prior to their implementation. Additionally, two trained university students conducted the survey.

There were three parts in the questionnaire. The first part included the concept of ecosystem services, PES, compensation mechanism, consumption of ecosystem goods, and perception of respondents in order to elicit data on awareness of residents about the situation of BWS. Similarly, the second part included the hypothetical scenario, discrete choice questions for acquiring information related to the resident's willingness-to-pay, and debriefing questions related to why they were willing to pay and the reasons behind why they were not willing to pay for watershed conservation. Lastly, the third part focused on the socioeconomic characteristics of respondents.

We first explained our hypothetical scenario as below: "*Assumed that no environmental law exists, thus no government measures regarding the protection of the watershed. Also, there is no organization in charge of this protection and conservation. If no action is taken, the lake condition is expected to deteriorate in the next few years. This deterioration includes loss of soil productivity, increased risks of floods which will destroy crops in the wetland; low productivity of fish and an increase in water hyacinth (an aquatic weed) leading to the loss of the wetland scenic beauty, which will thus lead to no tourism and recreational activities.*

Assumed the Begnas Watershed Association proposed a program to restore and manage degraded watershed areas surrounding your place for 5 years. The program comes with five key benefits: increased tree vegetation for flood control, improved water quality by reducing excess nutrient contamination and other sources of pollution, improved habitat for threatened native plants and animal species, maintained place for

recreation (fishing, sightseeing, and bird-watching), and a beautiful landscape view. In order to effectively implement this proposal, all households will be asked to voluntarily contribute".

Then, we examined whether or not the respondents were willing to pay or not for the protection of the watershed by asking the question, "Would you be willing to pay for watershed conservation?" In a particular situation, when a respondent was not willing to pay, we included an open-ended question requesting for the reasons. For respondents who were willing to pay for watershed conservation, a set of cash ($4.55, $9.09, $10.91, $13.64, $18.18, and $22.73) and kind contribution (4 days, 6 days, 8 days, and 10 days) options were presented. Then, they were asked to choose one of them as annual household contribution including other follow-up questions. After the hypothetical scenario, we asked the following questions: (1) Do you will to contribute to sustainable management and conservation of Begnas watershed for 5 years? (2) If yes, what would you prefer; in cash or kind? (3) What maximum amount do you want to pay per year? (4) If you want to contribute by providing labor hour, how many days would you like to contribute per year? And (5) please indicate the reasons why do you want to contribute.

Table 1 Description of variables used in Heckit model to quantify respondent willingness-to-pay for a watershed conservation program

Variables	Description	Mean	SD
Dependent variable			
wtp[a]	Respondent willingness-to-pay for a watershed conservation program. Binary variable: 1 if a respondent interested to pay for the program, and 0 otherwise	0.805	–
Max_payment[b]	Maximum willingness-to-pay amount of a respondent. Continuous variable (US$ per yr)	34.21	13.95
Independent variable			
Gender1	Respondent gender: Binary variable 1 if male and 0 for female	0.41	–
Age2	Respondent age in years. Continuous variable	47.23	13.11
Household size3	Number of members in a household. Continuous variable	4.78	1.97
Education4	Formal education completed in number of years. Continuous variable	7.58	4.42
Occupation5	Respondent occupation. Binary variable: 1 if respondent is involving in agriculture or tourism business or both, and 0 otherwise	0.46	0.50
Income6	Respondent annual household income. Continuous variable (100$)	31.63	19.35
Land7	Private property area owned by respondent in hectare. Continuous variable	4.49	5.86
Familirity8	Respondent familiarity with ecosystem services and payment for ecosystem services. Binary variable: 1 if respondent is familiar, 0 if not familiar	0.91	–
Env_member9	Executive member of environmental or natural resources management organizations. Binary variable: 1 if respondent hold position in executive committee, 0 if not	0.71	–
Housewaste10[a]	Opinion of respondent about watershed degradation: Binary variable: 1 if respondent believes household waste disposal caused watershed degradation, 0 if not	0.24	–
Lamda	Inverse mills ratio	0.33	0.28

[a]Used in probit model only

[b]Used in ordinary least squares regression only

7 Variable description

Based on the implications of economic theory and results from past studies, explanatory variables were selected and used to explain the variability in the dependent variables (Table 1). Before running the model, a detailed study of the correlations between the explanatory variables was carried out in order to avoid possible co-linearity. The multicollinearity among explanatory variables was checked by calculating the variance inflation factor (VIF). It turned out that only respondents working in the environment-related organization have a perfect correlation with the respondents' representation in the environmental or natural resource management committee. Thus, the variable respondent working in the environment or natural resource management committee was dropped from the models.

8 Results

8.1 Socioeconomic attributes of respondent

The socioeconomic profiles of the respondents are presented in Table 2. Among the respondents, 41% were male and 59% were female. Similarly, people of age-group 55–64 were the majority (30%) followed by 35–44 age-group (27%). Furthermore, 52% of respondents have more than four members in their family. Similarly, the result showed that 77.5% had attained primary school and the remaining 22.5% had attained higher education (greater than 8 grades). About 71% of the respondent worked as executive member of community forest user groups and environmental conservation groups, which proves they have some understanding about watershed management. A total of 46% of respondents were engaging in tourism activities (fishing, boating, hotel services, and tour operators) and agriculture, whereas 54% respondents were in government services, foreign labor, daily wages, and other businesses. The majority of respondents' (52%) annual household income was distributed at about US$ 1818–US$ 2727.

9 Residents' perception toward the importance of watershed ecosystem services and causes of its degradation

From rigorous discussion with stakeholders, we selected fish, fuelwood, recreation, boating, irrigation, carbon, biodiversity, medicinal herbs and future use value as major ecosystem services in BWS. Among the top selected good and services, we asked the individual respondents to assign rankings from 1 for highly prioritized service to 9 for least prioritized based on their importance. The respondents ranked water-based recreation as the most important ecosystem service followed by erosion control and future use value (Table 3).

Of the total sampled households, only 17% were involved in conservation and awareness programs in the Begnas watershed system. It might be due to the level of awareness and knowledge about ES is low among the respondents and majority of old-age respondents. In addition, millennials and adults temporarily lived away from the house for work. Around 41% of respondents reported that their businesses directly depended on the Begnas Lake. The result showed that the respondents located close to the lake

Table 2 Summary of demographic characteristics of respondents (total sample size = 400)

Variables	Factors/levels	Frequency	Percentage (%)
Gender	Male	164	41.00
	Female	236	59.00
Age (years)	18–24	15	3.75
	25–34	51	12.75
	35–44	108	27.00
	45–54	68	17.00
	55–64	121	30.25
	≥ 65	37	9.25
Household size (number)	1–4	192	48.00
	≥ 5	208	52.00
Education level	Below high school	310	77.50
	High school	46	11.50
	Bachelor	32	8.00
	Masters and above	12	3.00
Occupation	Agriculture and tourism	185	46.25
	Other	215	53.75
Annual income (US dollars);	< 909	33	8.25
	909–1818	113	28.25
	1818–2727	210	52.50
	2727–3636	40	10.00
	3636–4545	4	1.00
	> 4545	0	0.00
Participation in CF and environmental organizations	Yes	285	71.25
	No	115	28.75
Land holding (hectare);	< 0.25	303	75.75
	0.25–0.50	55	13.75
	0.50–0.7515	22	5.50
	> 0.75	20	5.00

US$ 1 = NRS 110

1 hectare = 19.60 *ropani*

had a high degree of dependence for their livelihoods. Similarly, the satisfaction level of respondents with the wetland (lakes and rivers/streams) ecological environment was found to be relatively low (4%). However, more than 90% inhabitants agreed that the watershed is important to them.

Population growth, overexploitation of natural resources (forests, stone, and sand mining), industrial wastes, household waste disposal, and natural disasters were responsible factors for ecosystem services degradation. Nevertheless, people have different understanding in indicating their risk level; 64% residents believed that population growth was the major reason behind watershed degradation (Table 4), whereas only 11% residents agreed natural disasters pose high risk for watershed ecosystem services. A total of 40 to 44% residents perceived that waste disposal and overexploitation of natural resources were the main causes of the watershed degradation.

Table 3 Major watershed ecosystem services and their ranking

Ecosystem services	Mean	SD	Min.	Max.	Rank
Recreation	3.720	2.489	1	9	1
Erosion control	3.895	2.369	1	9	2
Future use	3.940	2.638	1	9	3
Biodiversity	4.265	1.927	1	9	4
Irrigation	4.848	2.288	1	9	5
Carbon	4.978	1.935	1	9	6
Fuelwood	5.775	2.459	3	9	7
Fish and other food	6.692	2.673	1	9	8
Medicinal herbs	6.888	1.969	2	9	9

SD = Standard deviation

Table 4 Resident perception about causes of watershed degradation ($N = 400$)

Cause of degradation	Risk level (number of responses)		
	High	Medium	Low
Population growth	256	102	42
Overexploitation of natural resources	175	71	154
Industrial waste	165	126	109
Household waste disposal	160	84	156
Natural disasters	44	17	339

10 Willingness-to-pay for watershed conservation

We focused on residents' decisions regarding their willing to pay or not to pay for the conservation and management of BWS. Of the total sampled respondents, 322 (80.5%) respondents were willing to pay, while 78 (19.5%) respondents were not ready to pay. Of 322 residents who were interested to pay for watershed conservation, 9.63% residents stated that they would pay in cash only, 60.56% in kind (labor contribution), and 29.81% in both ways. Among the total respondents who were willing to pay, 48% were willing to pay to assure existing goods and services for the future generation, 23% were for securing watershed services for the future, 16% for quality goods, and 13% for operating tourism and recreational activities smoothly. Similarly, among refusing to pay, more than 50% thought protection of watershed comes under the government's responsibility, whereas about 30% were refusing to pay because of poor economic status (Table 5).

The average WTP of interested people for watershed conservation was US$ 33.95 $year^{-1}household^{-1}$. This was a conditional WTP amount, and minimum and maximum values of 95% confidence interval were US$20.30 and US$48.91/year/household, respectively. Similarly, the residents were willing to pay for a 5-year period for watershed management program focusing on ecosystem services.

Table 5 Respondents' reasons for paying or not paying for the conservation and management of BWS

Statements	Percentage (%)
Acceptance for WTP ($N=322$)	
Get a better quality of goods	16
Continuous watershed service over time	23
Assure existing goods and services for future generations	48
Tourism, irrigation	13
Rejection for WTP ($N=78$)	
My household is satisfied with the current status of the watershed	5
My household cannot afford to pay for the protection of the watershed	29
I/we think this is not the priority	12
The government should be responsible for the protection of the watershed	54

Table 6 Probit model to determine the probability of respondent willingness-to-pay in watershed conservation program (first stage of Heckit model)

Variables	Coefficient	Standard error	Marginal effect
Gender1 (Male)	0.4501**	0.1757	0.0967
Age2	−0.0164**	0.0065	−0.0036
Hhsize3	0.1404***	0.0474	0.0310
Education4	0.0519**	0.0227	0.0115
Occupation5	0.3295*	0.1774	0.0721
Income6	0.0170***	0.0060	0.0038
Land7	0.0611***	0.0211	0.0135
Familiarity8	−1.0517**	0.4549	−0.1630
Env_member9	0.1128	0.1835	0.0254
Housewaste10	0.0564	0.1921	0.0123
Constant	0.5541	0.6473	
Observations	400		
Log likelihood	−155.93		
Likelihood ratio	82.86		

***$p<0.01$, **$p<0.05$, *$p<0.1$

11 Factors affecting resident willingness-to-pay for watershed conservation

Table 6 presents factors influencing respondents' decisions about willingness-to-pay for the watershed conservation program. Gender (male resident), household size, education level, occupation (tourism and agriculture), household income, size of private lands, and opinion about household waste disposal had a positive effect, whereas the resident age and familiarity about ecosystem services and PES seemed negative effect on their decision about WTP. This indicates that one's likelihood of paying or not paying was affected by their socioeconomic characteristics and level of awareness about conservation. The positive sign in case of gender denotes that male residents were associated with a higher propensity to participate for a sustainable watershed conservation. Similarly, the positive sign in case of income suggests that a greater income was associated with a higher propensity to participate for a sustainable watershed conservation, that is, if the household income increased $100 yearly, the probability of

Table 7 Ordinary least-squares model to estimate respondent maximum willingness-to-pay amount for watershed conservation program (second stage of Heckit model)

Variables	Coefficient	Standard error	Total effect
Gender1	4.8883***	1.8744	4.0676
Age2	−0.2128***	0.0710	−0.1829
Hhsize3	0.1767	0.4907	−0.0792
Education4	0.3387*	0.2009	0.2440
Occupation5	−1.6196	1.7399	−2.2205
Income6	0.0270	0.0463	−0.0040
Land7	−0.2141	0.1663	−0.3255
Familiar8	−7.6873**	3.0161	−5.7696
Env_member9	0.4881	1.8336	0.2825
Inverse mills ratio (lamda)	5.2048	7.6611	
Constant	44.3009***	5.8401	
Observations	322		
R^2	0.1157		
F test (10, 311)	4.0700***		
Rho	0.3880		
Sigma	13.4150		

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

WTP would be increased by 0.38%. The positive sign of the parameter related to occupation shows that residents associated with tourism business and agriculture have propensity to participate more for watershed conservation than residents associated with other businesses. In terms of marginal effect, the result showed that with a hectare increase in size of land holding, the probability of willingness-to-pay for watershed conservation increases by 1.35%. Similarly, with the increment of one person in a household, the probability of willingness-to-pay for watershed conservation increases by 3.10%. The parameter, residents' familiarity about watershed ecosystem services, having negative sign means higher knowledge about ecosystem services is associated with a lower proclivity to contribute in watershed conservation. Similarly, the negative sign on age indicates younger residents are associated with a higher propensity to participate for sustainable conservation of watershed.

Table 7 describes which factors affect the respondents' willingness-to-pay amount (payment amount), while residents were interested to pay for watershed ecosystem services. Gender (male resident) and education level were significant and positively associated with the payment amount. Likewise, resident age and familiarity with ecosystem services were negatively related to payment amount, meaning respondents who were younger and familiar with ecosystem services wanted to pay a lesser amount due to their belief that the government should contribute a higher amount for the conservation of watershed instead of local residents. The residents believe that the benefits from the watershed conservation are a public good, which will be distributed evenly among local residents, and are also a source of revenue for the government. Thus, they perceived that the fund should come from government bodies instead of the residents.

12 Discussion

Residents' WTP for watershed conservation seemed to be influenced by individual's environmental awareness level and socioeconomic status, such as gender, age, household size, education level, income, property size, and familiarity with ecosystem services. In terms of the WTP amount, the average amount that respondents were willing to pay for watershed conservation was US$ 33.95 year^{-1} household^{-1}. The total WTP for ecosystem services produced in the Begnas watershed was $203,598.15 year^{-1}. The aggregate amount of WTP for whole watershed was computed based on average WTP amount per household ($33.95 per year) and total number of households in the watershed (5997 households). In this study, the aggregated WTP amount helps to quantify the total economic value of ecosystem services currently invisible in decision-making domains. The total economic value of ecosystem services shows the benefits of the watershed conservation program in the Begnas watershed. Thus, the conservation costs to implement a watershed management program below the aggregated WTP amount do not outweigh the benefits and justify its implementation economically.

The average WTP of residents for watershed ecosystem services was estimated to be US$ 33.95 year^{-1} household^{-1} in Begnas watershed, which is comparable with the study conducted by Baral et al. (2016), in Jagdishpur wetland site, Nepal (US$ 27.55 year^{-1} household^{-1}). Our estimated WTP amount is substantially higher than the Lamsal et al., (2015a, 2015b) in Ghodaghodi Lake complex, Nepal (US$ 5.4 year^{-1} household^{-1}), Bhandari et al. (2016) in Chure region of mid-western Nepal (US$ 4.15 year^{-1} household^{-1}), and KC et al. (2013) in protected area of Nepal (US$ 0.48 year^{-1} household^{-1}), whereas lower than Shrestha et al. (2007) in Koshi Tappu Wildlife Reserve, Nepal (US$ 238 year^{-1} household^{-1}), and Bhandari et al. (2018) in Panchase Protected Forest, Nepal (US$ 90.37 hectare^{-1} year^{-1}). The low willingness-to-pay in the Begnas watershed might be due to low levels of local participation in income generating activities than the Koshi Tappu Wildlife Reserve. The reason might be the Begnas watershed was recently declared Ramsar site, whereas Koshi Tappu is not only Ramsar site declared on 1987 but also an important wildlife reserve and has been launching several income-generating activities since the declaration of Ramsar site and reserve. Similarly, higher biodiversity, religious, and cultural values might be the reason in case of Panchase Protected Forest compared to our site.

As our presumption younger (adult) and more educated residents desired to pay more for watershed conservation, the results of the study also came as expected later on. Our finding was consistent with the finding of Yu et al. (2018), Bhandari et al. (2016), and Nicosia et al. (2014). As educated young people have greater concern on ecosystem services than aged, their willingness-to-pay is also higher. Likewise, respondents who were engaged in forest management and environmental conservation groups were more interested for WTP than others. This result was consistent with Lamsal et al. (2015a, 2015b) and Kaffashi et al. (2013). The households having a larger family size and owning more land were more inclined for WTP, which is consistent with the finding of Bhandari et al. (2018). In the same way, respondents who were getting benefits from the watershed or whose business/occupations were directly related to tourism and agriculture were more likely to participate in watershed conservation program than respondents involved in other occupations.

The independent variable household income is positively and significantly related to the WTP. Thus, the household with high household income had a higher propensity to pay for conservation of BWS than households with a lower income. This finding is consistent

with Bhandari et al. (2018); Paudyal et al. (2015); and Bhandari et al. (2016). Similarly, male residents had higher proclivity to pay for watershed ecosystem services, and this finding is similar to the finding by Khanal et al. (2010). The study conducted by Wang & Jia (2012) and Yu et al. (2018) stated that awareness of being in a protected area had a strong positive impact on the WTP because the respondents who were willing to pay more for biodiversity conservation had a strong educational background on ecology and its importance. Their study finding contradicted with our finding that residents' familiarity with ecosystem services was negatively related to paying for watershed conservation. Residents of Begnas watershed did not have a strong education background and higher awareness on ecology and ecosystems; however, residents living in close proximity to the Begnas Lake were getting benefits (earning from fishing and boating) from the lake; for example, an indigenous *Jalari* community whose livelihood depends on fishing from the lake has a high WTP for the conservation of the watershed despite their lack of knowledge about ecosystem services.

Majority of respondents in this study agreed on financial contribution for paying to protect the watershed ecosystem services for their own use and benefit for their future generations. The average payment amount of BWS was slightly higher than the payment amount in other sites of Nepal. Thus, it is possible to develop an institutional mechanism by the participation of ecosystem service providers, service users, and intermediaries for watershed conservation in BWS (Bhatta et al., 2018; Rai et al., 2018, Aryal et al., 2019 and Thapa et al., 2020). They agreed on paying landowner under PES to protect and manage the watershed for sustainable provision of ecosystem services. The estimation of the total monetary value of watershed assists the analysis of the trade-offs between its conservation and other development activities and also guides watershed management efforts and public investments to protect and enhance the benefits from the watershed (Harris & Roach, 2013; Suyanto et al., 2005; Verma & Negandhi, 2011). In fiscal year 2019/20, Pokhara Metropolitan City has allocated $5.8 million for overall development of this study area (ward 28, 30 and 31). Our study suggests that a 3.5% amount of total local body budget can be invested for watershed conservation such as forest management, reducing nonpoint source water pollution, improvement of wildlife habitats, and bio-engineering activities.

The main contribution of this study was to determine the proportion of local development budget on the conservation of watershed ecosystem services. As expected, residents associated with agriculture and tourism businesses highly valued the watershed ecosystem services; however, this study did not support the previous finding of positive relationship between familiarity with ecosystem services and WTP. This study calculated total WTP based on the average WTP amount and total households of the study area but did not consider households who bear opportunity costs due to watershed protection. The study would have been stronger if both the WTP and WTA were studied simultaneously. Moreover, since this study is related to the residents' socioeconomic characteristics, the data required depend heavily on their honesty and cooperation in giving accurate information. The relatively high rate of "Yes" responses to WTP questions probably showed that there might be some limitations in this study due to either a "yes-saying" bias or pleasing attitude of respondents toward interviewers or low level of bidding prices offered. Thus, we suggest more attention is indeed to narrow down such limitations while designing field survey for data collection.

13 Conclusions and implications

The BWS, basis of local livelihood, has been offering multiple good and services: fishing, boating, drinking water supply, irrigation, carbon pools, recreation, retention of sediments, and other tourism activities. The total monetary value of ecosystem services produced in the BWS was \$203,598.15 year^{-1}, where 80.5% of total respondents were interested for the contribution to BWS conservation. An individual household was ready to pay about US\$ 33.95 annually in average, whereas local institution could invest up to 3.5% of their total budget annually for watershed conservation. The computed WTP would work as strong backstopping to strengthen PES scheme for sustaining available benefits and lake existence. Though BWS is a Ramsar Site having international importance, both total and individual WTP for its conservation are less compared to other Ramsar Sites existing in Nepal. So, its importance should be publicized at local, national, and global levels by organizing different promotional activities.

The findings clearly indicate socioeconomic characteristics affect sustainable conservation of BWS. Factors such as gender (male resident), household size, education level, occupation (farmers and tourism entrepreneurs), household income, and landholding size positively, and resident age and familiarity with ecosystem services negatively influenced residents in deciding for WTP. The gender and education level were statistically significant and positively associated with incremental payment amount Therefore, residents such as female, educationally poor, having less landholding size and income, unemployment, and unknown about importance of ecosystem services should be targeted while designing the plan and organizing conservation activities in favor of BWS.

The government should strictly prevent further degradation of these resources and develop specific policies to improve the ecosystem attributes of watershed. There is a need of an independent "Watershed Management Committee" having the authority of formulating strategic plans. Sustainability of watershed and ecosystem services is only possible from locally acceptable management programs. Management plan formulated by the government often ignores heterogenetic preferences of local residents (Aryal et al., 2019) and becomes unsuccessful to derive measurable output. So, the finding of this study, covering wide range of interest groups, could be more insightful to policy makers in designing implementable plans.

Acknowledgements Heartfelt gratitude to Beijing Forestry University for providing us a platform to conduct this research. A special thank goes to Santosh Paudel and Pratikshya Dahal from Institute of Forestry (IOF), Pokhara, Nepal, for their assistance during data collection. We would also like to thank our language editor, Carolina Rodriguez for insightful feedbacks and corrections.

Authors' contribution For research, S.T. collected and organized all the data. The data were analyzed by S.T and R.K.A. and guided by S.B. who also helped in conceptualization this research. S.S, D.P, D.G., and A.K advised the process of writing the paper and also contributed to revise the manuscript. All authors contributed to writing the manuscript and agreed to submit to Environment, Development and Sustainability journal for publication.

Funding This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Data availability The data used to support the findings of this study are available from the corresponding author upon request.

Declarations

Conflict of interest The authors declare no conflicts of interest.

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